Contextualized Language Model-based Named Entity Recognition in Slovak Texts

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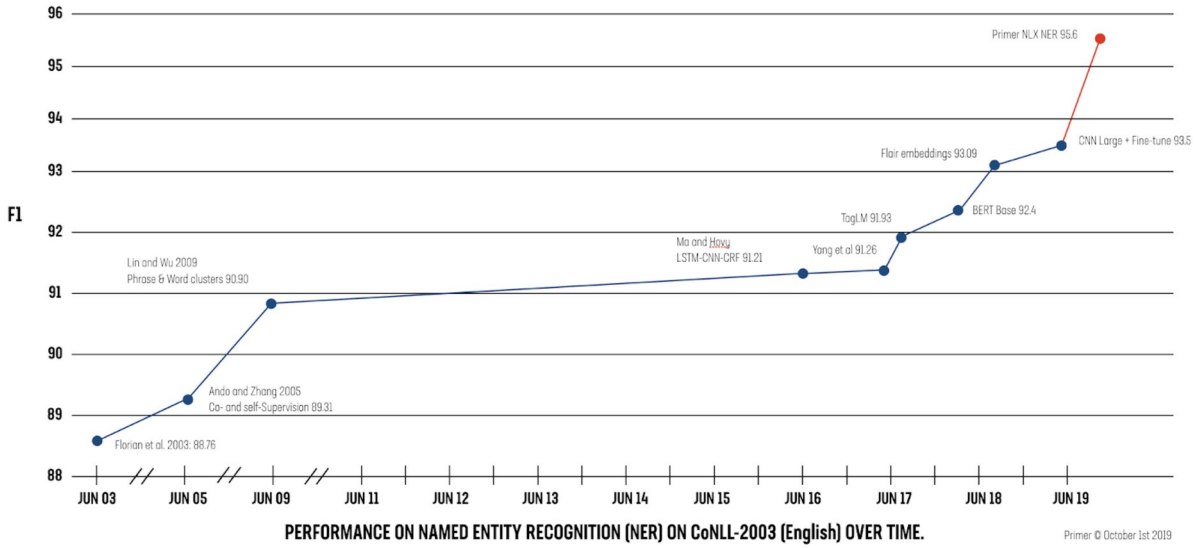
Named Entity Recognition (NER)

- recognition and categorization of named entities in text
- Person, Location, Organization, Product, Time ……
- one of the base tasks in NLP (applications: information extraction from CV, recommender systems...)

source: https://www.aiimi.com/insights/aiimi-labs-on-named-entity-recognition

Motivation

- state-of-the-art are contextualized language models based on deep neural networks
- the best systems for NER in slovak texts are rule based and are far behind [1]
- the main reason is lack of resources and datasets



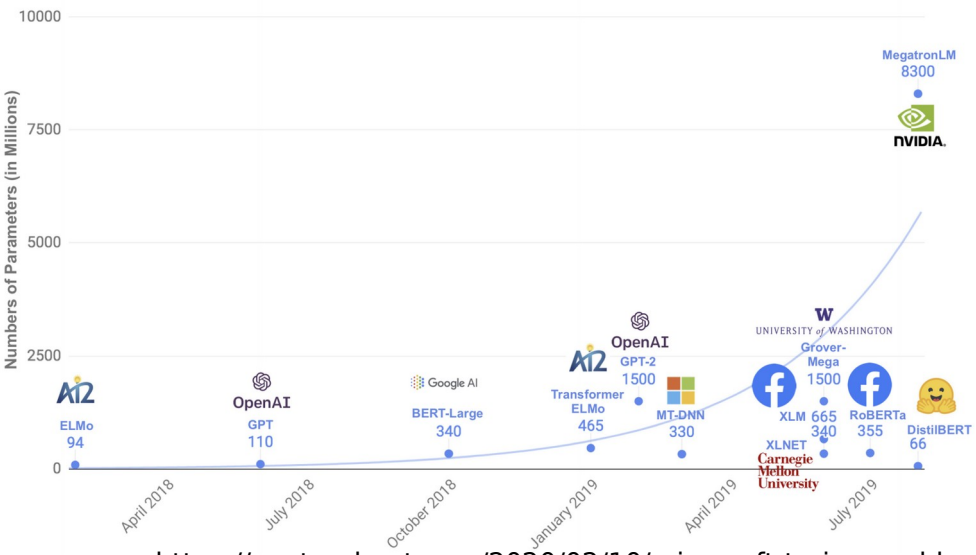
source: https://company.primer.ai/blog/a-new-state-of-the-art-for-named-entity-recognition/ww.aiimi.com/insights/aiimi-labs-on-named-entity-recognition

Goals

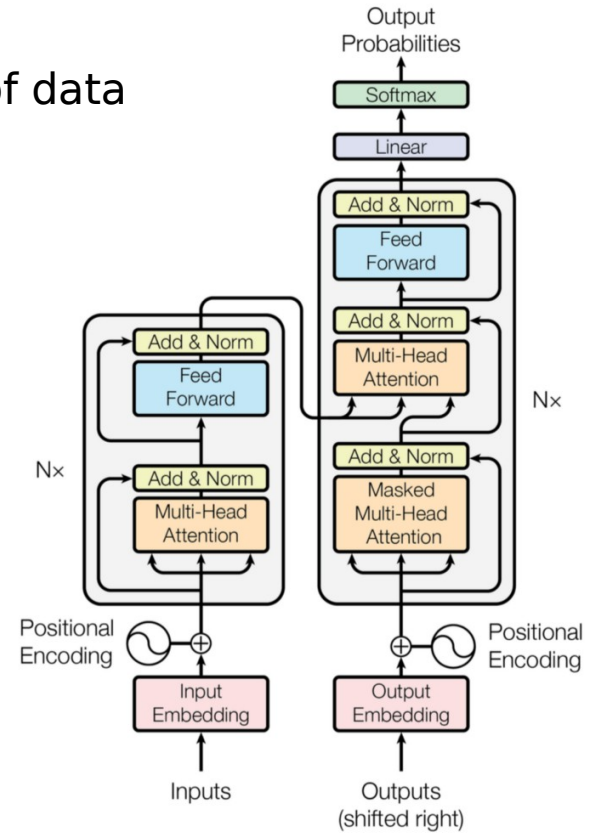
- utilize, improve and expand existing slovak NER datasets
- use large multilingual language models and transfer learning for named entity recognition in slovak texts

Transformers language models

- BERT (Google), GPT-2/3 (OpenAI), RoBERTa (Facebook), ALBERT (Google)
- deep-learning models with attention layers
- state-of-the-art standard
- trained unsupervised on huge amounts of data
- fine-tunning for specific tasks (transfer learning)



source: https://venturebeat.com/2020/02/10/microsoft-trains-worlds-largest-transformer-language-model/



source: [2]

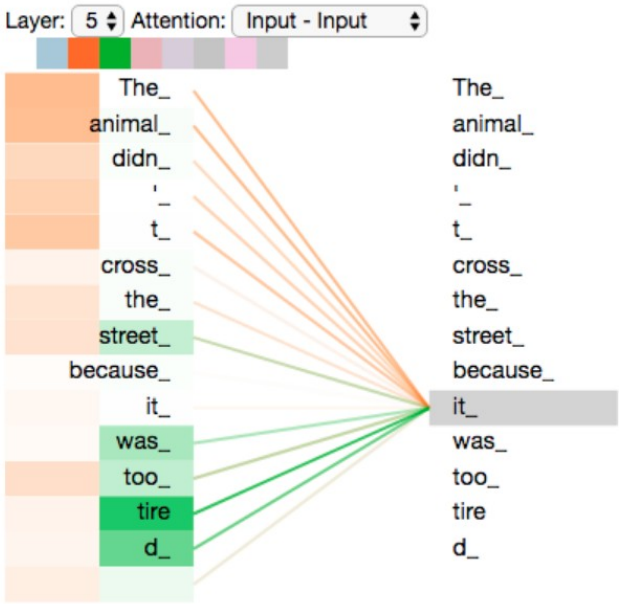
Transformers language models

- attention: the attention-mechanism allows model to decide at each step of sequence which other parts of the sequence are important
- Q – query vector (word in a sequence)
- K – keys (all words in sequence)
- V – values (all words in sequence)

$$\text{Attention}(Q, K, V) = \text{softmax}(\frac{QK^T}{\sqrt{d_k}})V$$

- positional encoding: allows model to utilize order of sequence

$$PE_{(pos,2i)} = sin(pos/10000^{2i/d_{\text{model}}})$$
$$PE_{(pos,2i+1)} = cos(pos/10000^{2i/d_{\text{model}}})$$



source: http://jalammar.github.io/illustrated-transformer/

Silver Standard Dataset (WikiANN)

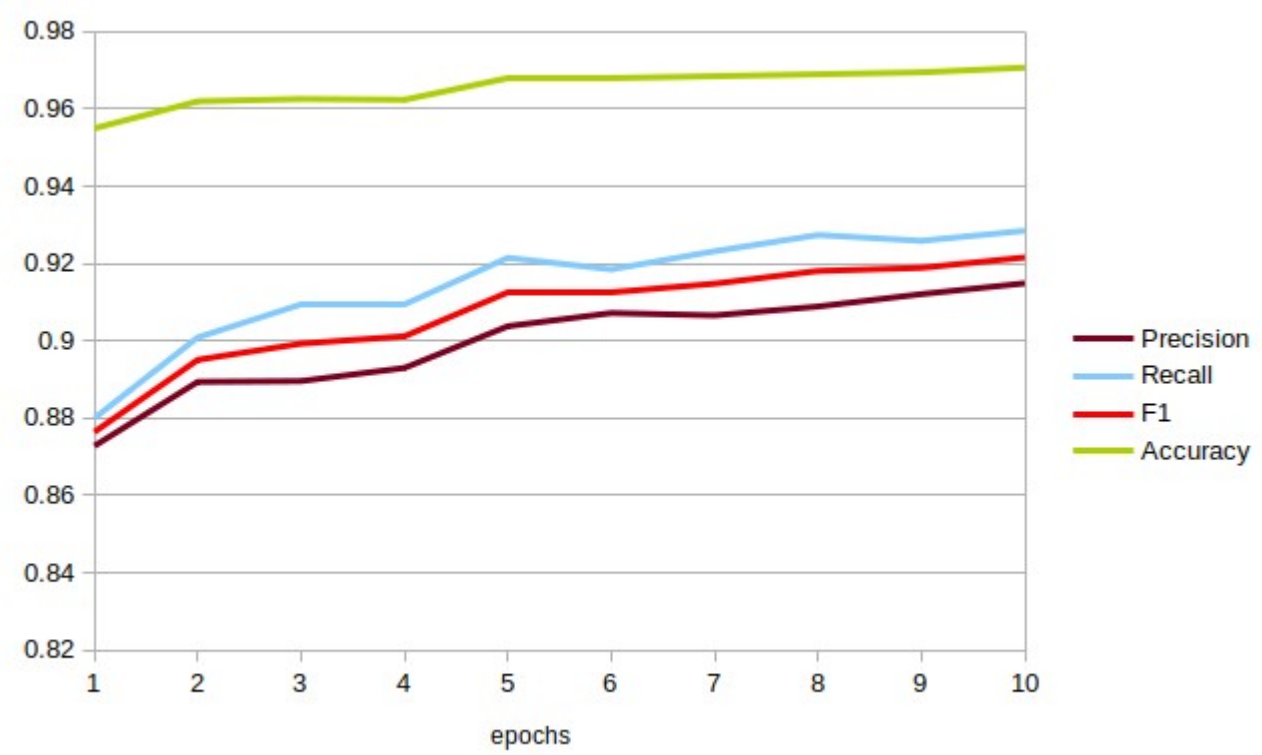
	Precision	Recall	F1
Trankit	88.9	88.51	88.7
Spacy: tok2vec + Transition-based parsing	84.49	82.96	83.72
Spacy: Multilingual Bert + Transition based parsing	92.64	92.33	92.49

Silver Standard Dataset (WikiANN)

- Oct 2021: **SlovakBERT** [1]
- KIIT and Gerulata
- the first Slovak-only transformers-based model trained on a sizeable corpus
- RoBERTa architecture, Web-crawled corpus (19.35 GB)
- evaluated on multiple NLP downstream taks (however not NER) and achieved state-of-the-art results
- we finetuned it with WikiANN dataset utilizing HuggingFace NER pipeline [2] with following results:

Precision	Recall	F1
91.4	92.8	92.1

Finetuning SlovakBert model



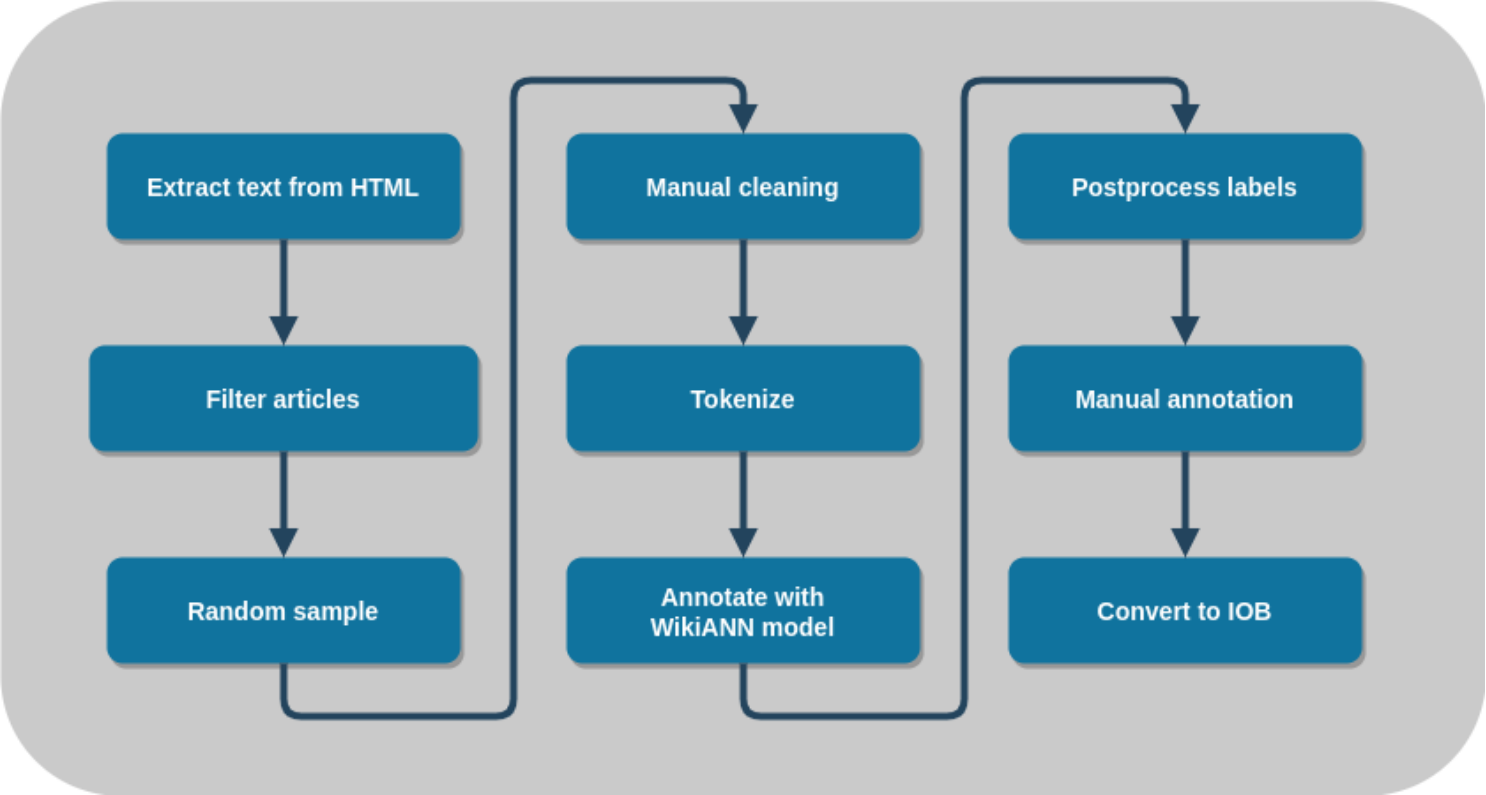
Gold Standard dataset creation

- necessity for proper evaluation
- possible sources:
  - Slovenský Národný Korpus [2]
  - newspaper web pages (SME, Aktuality, ...)
  - legal texts (slov-lex.sk, ru.justice.sk)
  - Wikipedia

- license without limitations is priority
- need for entity-rich texts
- only Wikipedia has Creative Commons license
- dumps.wikimedia.org/skwiki/latest/

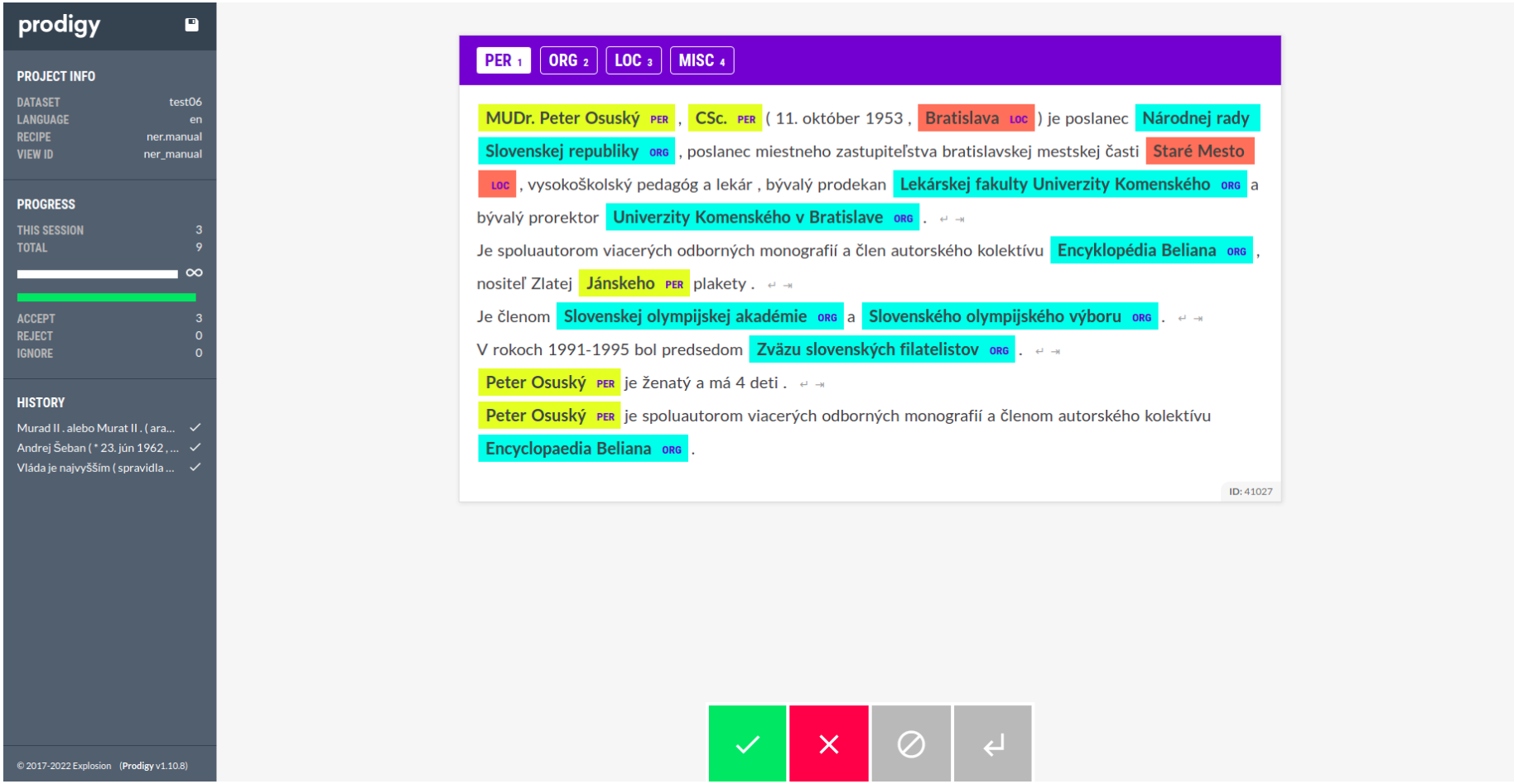
Gold Standard dataset creation

- Goal: 15k labeled entities



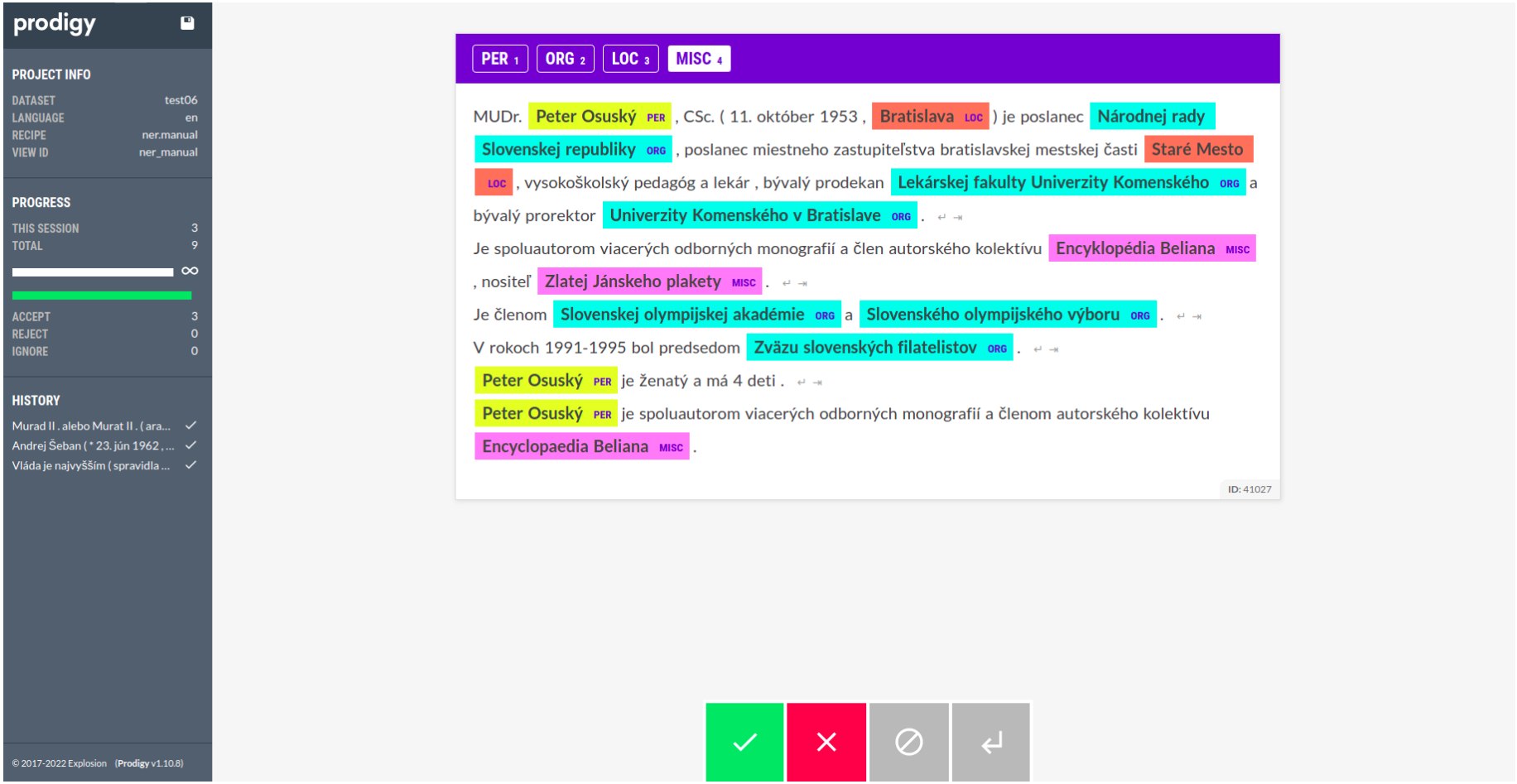
Prodigy

- before manual labeling



Prodigy

- after manual labeling



Next steps

- train/finetune most common NER models with created dataset
- use data augmentation method
  - Pattern Exploiting Training [3] – uses masked language modeling with pretrained language models for few-shot learning

    ‘I am student of Matfyz. Matfyz is <masked>.
- utilize transfer learning from close languages (e.g. czech)

Literatúra

- [1] Kaššák, Ondrej - Kompan, Michal - Bieliková, Mária. Extrakcia pomenovaných entít pre slovenský jazyk. In ZNALOSTI 2012 : Sborník příspěvků 11 ročníku konference, Mikulov, hotel Eliška 14.-16. 10. 2012. Praha:Matfyzpress, 2012, pp. 52–61
- [2] Pikuliak, Matúš, et al. SlovakBERT: Slovak Masked Language Model. arXiv preprint arXiv:2109.15254 (2021).
- [3] https://github.com/huggingface/transformers
- [4] https://korpus.sk/
- [5] Tam, Derek, et al. Improving and simplifying pattern exploiting training. arXiv preprint arXiv:2103.11955 (2021)

Key articles

- Suppa, Marek and Jariabka, Ondrej. 2021. Benchmarking Pre-trained Language Models for Multilingual NER: TraSpaS at the BSNLP2021 Shared Task. InProceedings of the 8th Workshop on Balto-Slavic Natural Language Process-ing, pages 105–114, Kiyv, Ukraine. Association for Computa-tional Linguistics.
- Afshin Rahimi, Yuan Li, and Trevor Cohn. 2019. Massively multilingual transfer for ner. arXiv:1902.00193
- Pikuliak, Matúš, et al. SlovakBERT: Slovak Masked Language Model. arXiv preprint arXiv:2109.15254 (2021).

Thank you for your attention!